SCRAMBLED CODE LETTERS FOR PROGRESS REPORT 68
PROJECT 1108-17

Company - Mill	Machine No.	Code Letter
The Chesapeake Corporation - West Point	1	--
Continental Can Company, Inc. - Hopewell	1	K
Crown Zellerbach Corporation - Baltimore	1	J
- Baltimore	2	D
- Bogalusa	4	G
- Dresden	1	O
- Lebanon	2	M
International Paper Company - Bastrop	1	S
- Bastrop	2	--
- Georgetown	1	P
- Georgetown	2	--
The Mead Corporation - Harriman	1	E
- Knoxville	1	--
- Lynchburg	2	L
- Sylva	1	N
Muskingum Fibre Products Company - Coshocton	1	R
North Carolina Pulp Company - Plymouth	3	F
Olin Mathieson Chemical Corporation - Monroe	1	--
- Monroe	2	--
Owens-Illinois Glass Company - Tomahawk	1	I
- Tomahawk	2	N
- Tomahawk	3	C
- Big Island	1	--
- Big Island	2	--
- Big Island	3	Q
St. Joe Paper Company - Port St. Joe	1	B
Union Bag-Camp Paper Corporation - Savannah	2	A
West Virginia Pulp and Paper Company - Covington	6	T
- Covington	7	--
- Charleston	--	--

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

SUPPLEMENTARY REPORT ON CALIPER OF SINGLE-FACED BOARD

Project 1108-17

Progress Report 68

to

FOURDRINIER KRAFT BOARD INSTITUTE, INC.

June 1, 1960

THE INSTITUTE OF PAPER CHEMISTRY

Appleton, Wisconsin

This report is supplementary to Progress Report 67 of the baseline study on corrugating medium entitled, "Continuous evaluation of corrugating medium" which provides a program whereby participating mills have the opportunity to submit rolls of medium on a regular weekly schedule for evaluation with regard to physical characteristics of the medium and of the single-faced board made from the medium. Specifically, each medium is evaluated for caliper, basis weight, and Concora flat crush. In addition each medium is fabricated into A-flute single-faced corrugated board on the Institute's corrugator to determine its runability in terms of speed and tension, and the single-faced board obtained at maximum speed with minimum tension is evaluated for its flat crush strength.

This report is an extension of the baseline study described above and is concerned specifically with the caliper and uniformity of caliper of the single-faced board fabricated from each roll of medium. Uniformity of caliper is generally considered to be another facet of the criteria used to evaluate the runability of corrugating medium, and the Technical Committee of the Fourdrinier Kraft Board Institute, Inc., has requested that a measurement of the uniformity of caliper be included as a part of the evaluation given each roll of corrugating medium.

The evaluation of the caliper and uniformity of caliper of the single-faced board made from each roll of corrugating medium was carried out using the five circular specimens that were subsequently tested for flat crush strength. Each specimen was five square inches in area. They were cut at intervals of approximately two feet along the central portion

of a strip of the single-faced board fabricated at maximum speed and minimum tension. On each of these five specimens, caliper measurements were made on five consecutive flutes and the caliper difference between consecutive flutes was calculated, there being four calculations of differences for each specimen. The twenty-five caliper measurements (five calipers on each of the five specimens) were averaged and are reported as the caliper for each sample of medium. Likewise, the twenty caliper differences between consecutive flutes (four caliper differences on each of the five specimens) were averaged, and the maximum, minimum, and average values are reported for each sample of corrugating medium.

The instrument for measuring the caliper of individual flutes of single-faced board consists of a bench-type thickness gage with a pressure foot 3/8 inch in diameter and an anvil consisting of a plane circular surface 2 inches in diameter. The pressure foot is attached to a dial indicator which can be read to 0.0001 inch. The load on the pressure foot is 100 $\pm$ 10 grams. A caliper determination is made by inserting each five-square-inch circular specimen between the pressure foot and the anvil so that the foot rests on the second flute from one end of the specimen without touching either of the adjacent flutes. The 3/8-inch diameter of the pressure foot permits it to contact only one flute with ease. The specimen is pressed gently against the anvil, and the reading is then recorded. As mentioned previously, five consecutive flutes through the center of each specimen are calipered in this way. It should be emphasized that these calipers may not necessarily correspond to regular caliper measurements because of differences in load and other variables.

Caliper data have been obtained on the single-faced board fabricated from each of the one hundred and twenty-eight rolls of corrugating medium which were submitted for evaluation during the month of May. Also included for purposes of convenient reference are the single-face flat crush and runability data. The current machine averages for each test are summarized in Table I for Machines A through T. A graphical presentation of the current machine caliper averages on single-faced board is shown in Figure 1, and a similar presentation of the current machine averages for the caliper difference between consecutive flutes is given in Figure 2. The test results obtained on the individual rolls of medium submitted by each company are given in Tables II through XXI for Machines A through T, respectively.

It may be seen in Figure 1 and Table I that the average caliper results for the single-faced boards varied from a low value of 192.9 points for Machine D to a high value of 197.0 points for Machine K. Likewise, from the results given in Table I and Figure 2, it may be noted that the average caliper difference between consecutive flutes ranged from a minimum of 1.6 points for Machines E, K, and S to a maximum of 3.0 points for Machine A. The majority of the machines were associated with average caliper differences of two points or less. The differences in the area of three points may be excessive.

TABLE I

SUMMARY OF CURRENT MACHINE AVERAGES
May, 1960

Machine	Number of Rolls	Caliper, points	Caliper Difference Between Consecutive Flutes, points	Single-Face Flat Crush, p.s.i.
A	6	195.1	3.0	33.1
B	6	196.4	2.7	29.4
C	8	196.0	2.6	35.4
D	6	192.9	1.8	31.9
E	4	195.9	1.6	30.4
F	3	Note a	Note a	Note a
G	8	196.0	2.4	31.5
H	4	196.2	2.1	33.4
I	8	196.2	1.8	35.3
J	6	194.8	2.0	30.7
K	9	197.0	1.6	34.5
L	4	196.9	2.1	32.9
M	1	196.8	2.9	29.3
N	9	196.3	1.9	34.5
O	6	194.9	2.8	31.1
P	8	196.4	1.8	35.4
Q	13	196.7	1.7	32.0
R	9	196.3	2.4	32.7
S	5	195.4	1.6	36.1
T	5	195.7	1.7	32.2
Total	128			

[a] Single-face flat crush and caliper could not be determined because the medium fractured even at a speed of 100 f.p.m.

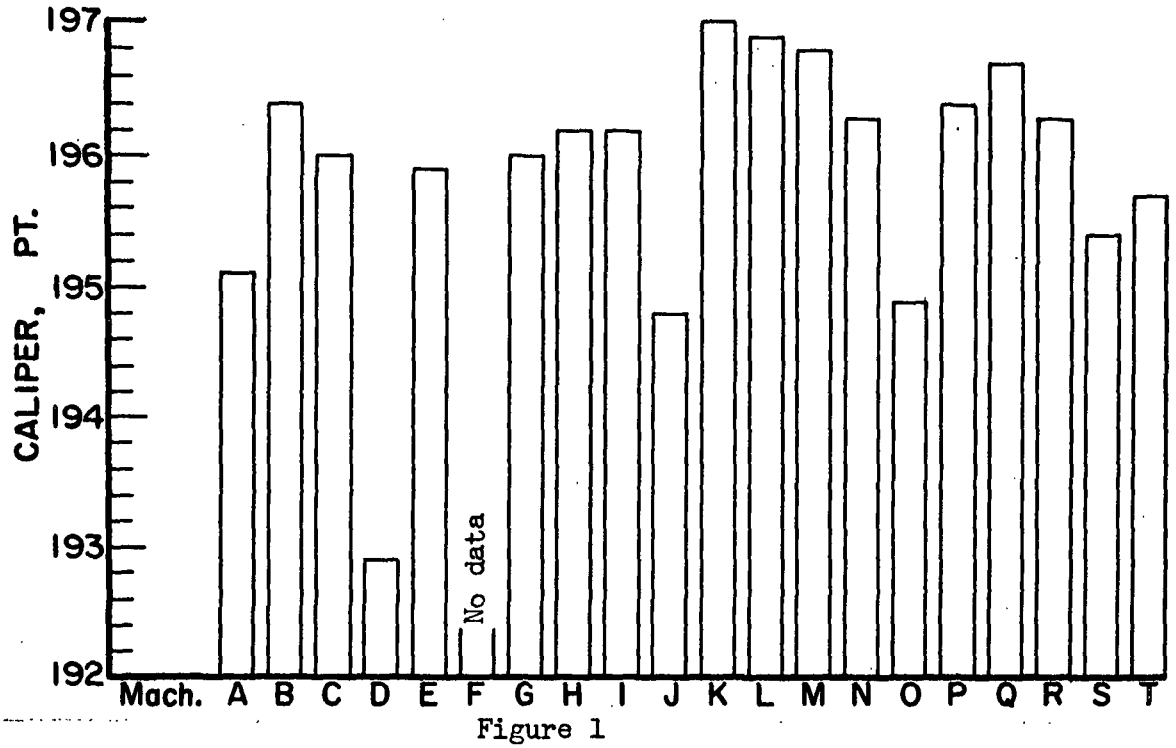

Figure 1

Comparison of Caliper Results on Single-Faced Board
May, 1960

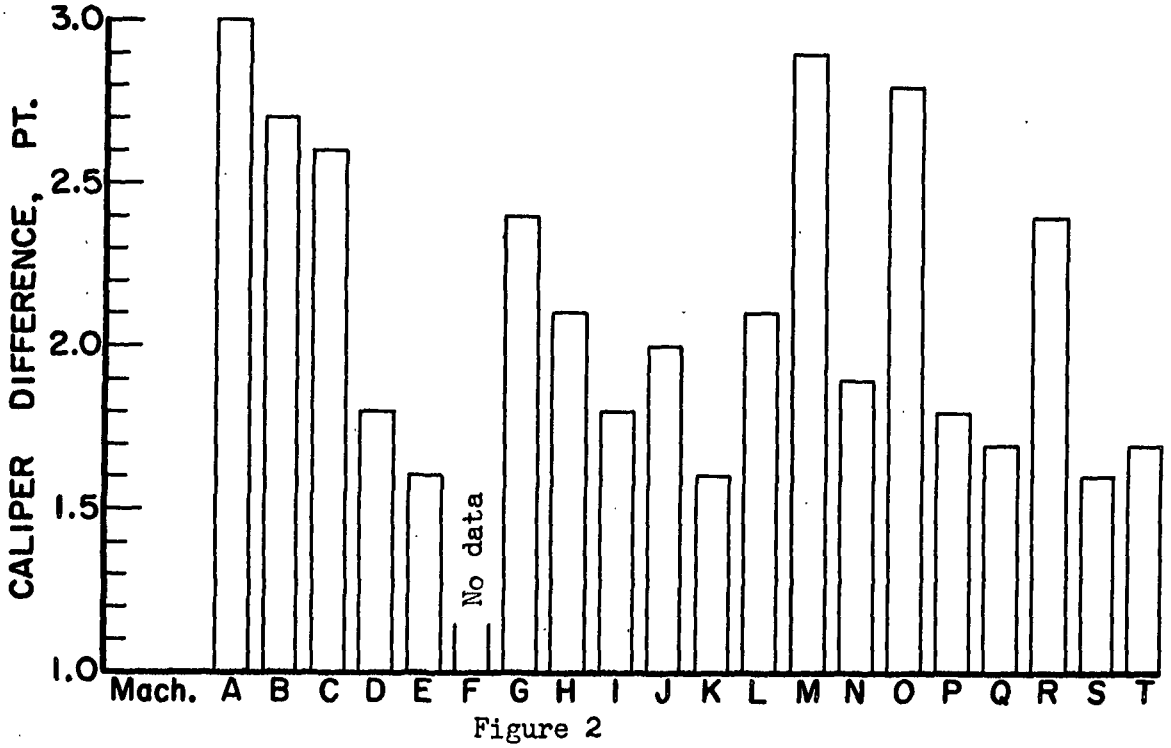

Figure 2

Comparison of the Caliper Differences Between Consecutive
Flutes of Single-Faced Board
May, 1960

TABLE II

SUMMARY OF TEST RESULTS FOR MACHINE A
May, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, points Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
A-1	4-16-60	364	194.7	7.7	0.4	2.8	33.2	Note a
A-2	4-19-60	365	193.0	12.5	0.2	6.3	31.2	Note b
A-3	4-21-60	366	196.0	3.5	0.6	1.8	35.5	1-1/2
A-4	5- 1-60	367	196.0	5.5	2.0	3.8	29.4	Note c
A-5	5- 2-60	368	195.3	4.2	0.6	2.1	35.3	1
A-6	5- 5-60	369	195.8	4.7	0.1	1.2	33.9	1
Current Machine Av.			195.1			3.0	33.1	

[a] Maximum speed at which this medium could be corrugated with minimum tension was 575 f.p.m.

[b] Maximum speed at which this medium could be corrugated with minimum tension was 375 f.p.m.

[c] Maximum speed at which this medium could be corrugated with minimum tension was 400 f.p.m.

TABLE III

SUMMARY OF TEST RESULTS FOR MACHINE B
May, 1960

B-1	4-15-60	13	195.7	11.0	0.9	4.1	28.9	Note a
B-2	4-15-60	14	196.2	7.1	0.4	4.2	28.9	1-1/2
B-3	4-15-60	15	196.4	5.5	0.4	2.5	30.1	1-1/2
B-4	4-15-60	16	196.2	4.6	0.5	2.4	29.0	1-1/2
B-5	4-16-60	17	196.8	3.2	0.0	0.8	30.7	1-1/2
B-6	4-16-60	18	197.0	4.6	0.1	2.3	28.6	1-1/2
Current Machine Av.			196.4			2.7	29.4	

[a] Maximum speed at which this medium could be corrugated with minimum tension was 575 f.p.m.

TABLE IV

SUMMARY OF TEST RESULTS FOR MACHINE C
May, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, points Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
C-1	4-20-60	--	194.7	8.8	0.1	3.4	35.6	Min.
C-2	4-23-60	--	195.4	6.3	0.1	3.2	37.3	Min.
C-3	4-27-60	--	196.1	5.0	0.4	2.2	33.1	1
C-4	4-30-60	--	196.6	4.9	0.0	1.4	35.1	1/2
C-5	5- 5-60	--	195.9	8.4	0.8	3.8	35.3	1/2
C-6	5- 7-60	--	197.0	6.9	0.1	2.5	35.0	1
C-7	5-11-60	--	195.9	5.8	0.0	2.1	36.5	1
C-8	5-14-60	--	196.8	5.7	0.5	2.4	34.9	1
Current Machine Av.			196.0			2.6	35.4	

TABLE V

SUMMARY OF TEST RESULTS FOR MACHINE D
May, 1960

D-1	4-18-60	17	192.4	5.5	0.1	1.7	33.1	1-1/2
D-2	4-18-60	18	193.4	5.1	0.0	2.1	32.7	1-1/2
D-3	4-19-60	19	192.6	4.2	0.1	1.8	32.7	1-1/2
D-4	4-19-60	20	192.6	4.4	0.1	1.7	34.4	1-1/2
D-5	5- 3-60	21	193.2	3.3	0.0	1.3	30.6	1-1/2
D-6	5- 4-60	22	193.2	4.5	0.1	2.0	28.2	1-1/2
Current Machine Av.			192.9			1.8	31.9	

TABLE VI

SUMMARY OF TEST RESULTS FOR MACHINE E
May, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, points Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
E-1	4-21-60	297	195.2	3.6	0.0	1.5	34.3	Min.
E-2	4-21-60	298	195.2	7.5	0.1	2.0	26.6	Note a
E-3	5- 4-60	305	196.3	2.4	0.3	1.2	30.4	1-1/2
E-4	5- 4-60	306	196.8	5.7	0.1	1.8	30.5	1-1/2
Current Machine Av.			195.9			1.6	30.4	

[a] Maximum speed at which this roll could be corrugated with minimum tension was 475 f.p.m.

TABLE VII

SUMMARY OF TEST RESULTS FOR MACHINE F
May, 1960

F-1	4-11-60	336	Note a	Note a	Note a	Note a
F-2	4-13-60	425	Note a	Note a	Note a	Note a
F-3	4-20-60	629	Note a	Note a	Note a	Note a

[a] Single-face flat crush and caliper could not be determined because the medium fractured even at a speed of 100 f.p.m.

TABLE VIII

SUMMARY OF TEST RESULTS FOR MACHINE G
May, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, points Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
G-1	4-20-60	44	195.5	4.1	0.1	1.7	30.0	1
G-2	4-25-60	45	196.2	6.3	0.3	3.0	33.6	1-1/2
G-3	4-26-60	46	195.3	5.9	0.3	1.9	31.1	1/2
G-4	5- 4-60	47	196.2	4.6	0.4	2.0	33.6	1-1/2
G-5	5- 5-60	48	196.3	6.0	1.2	3.3	31.8	1-1/2
G-6	5-10-60	49	194.8	5.5	0.5	2.7	32.8	1-1/2
G-7	5-16-60	50	196.7	2.9	0.5	1.7	30.8	1-1/2
G-8	5-17-60	51	196.8	5.6	1.1	3.2	28.3	1-1/2
Current Machine Av.			196.0			2.4	31.5	

TABLE IX

SUMMARY OF TEST RESULTS FOR MACHINE H
May, 1960

H-1	4-29-60	303	196.7	7.6	0.1	2.4	34.5	1-1/2
H-2	4-29-60	304	196.5	3.8	0.2	1.7	33.5	1-1/2
H-3	5-12-60	311	196.0	7.5	0.2	2.2	33.7	1-1/2
H-4	5-12-60	312	195.8	5.9	0.0	2.2	32.0	1-1/2
Current Machine Av.			196.2			2.1	33.4	

TABLE X

SUMMARY OF TEST RESULTS FOR MACHINE I
May, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, points Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
I-1	4-18-60	--	195.6	3.7	0.3	1.4	34.7	1
I-2	4-21-60	--	195.8	4.9	0.0	1.7	36.4	1
I-3	4-26-60	--	195.9	4.3	0.0	1.5	35.1	1
I-4	4-28-60	--	196.2	4.1	0.1	2.7	34.0	1/2
I-5	5- 2-60	--	196.7	4.6	0.7	2.1	36.5	1-1/2
I-6	5- 4-60	--	196.6	2.7	0.1	1.4	34.4	1-1/2
I-7	5- 9-60	--	196.4	4.3	0.0	2.1	36.8	1-1/2
I-8	5-12-60	--	196.2	3.6	0.1	1.4	34.6	1-1/2
Current Machine Av.			196.2			1.8	35.3	

TABLE XI

SUMMARY OF TEST RESULTS FOR MACHINE J
May, 1960

J-1	4-12-60	17	192.8	2.7	0.1	1.3	31.9	1-1/2
J-2	4-13-60	18	192.3	3.7	0.1	1.4	30.9	1/2
J-3	4-21-60	19	197.9	4.0	0.4	2.4	27.6	1-1/2
J-4	4-22-60	20	195.1	4.4	0.0	2.2	31.4	1-1/2
J-5	5- 2-60	21	195.8	4.2	0.3	1.5	31.4	1-1/2
J-6	5- 3-60	22	195.1	9.5	0.0	3.5	30.8	1-1/2
Current Machine Av.			194.8			2.0	30.7	

TABLE XII

SUMMARY OF TEST RESULTS FOR MACHINE K
May, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, points Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
K-1	4-14-60	260	198.8	7.1	0.2	2.6	32.7	1-1/2
K-2	4-18-60	261	196.9	2.5	0.3	1.0	33.6	1-1/2
K-3	4-20-60	262	197.0	6.4	0.0	2.2	34.5	1-1/2
K-4	4-25-60	263	196.8	4.6	0.0	1.1	34.6	1-1/2
K-5	4-27-60	264	196.6	4.4	0.2	1.6	35.1	1-1/2
K-6	5- 5-60	265	197.3	3.6	0.0	1.4	34.0	1-1/2
K-7	5- 7-60	266	196.9	3.9	0.0	1.4	36.7	1-1/2
K-8	5- 9-60	267	196.6	2.8	0.1	1.3	34.7	1-1/2
K-9	5-10-60	268	195.9	5.4	0.2	1.7	34.8	1-1/2
Current Machine Av.			197.0			1.6	34.5	

TABLE XIII

SUMMARY OF TEST RESULTS FOR MACHINE L
May, 1960

L-1	4-30-60	301	196.6	3.4	0.2	1.6	36.0	1-1/2
L-2	4-30-60	302	196.8	4.6	0.1	1.6	36.9	1-1/2
L-3	5-11-60	309	197.2	5.9	0.6	2.9	29.5	1-1/2
L-4	5-11-60	310	197.0	4.0	0.6	2.2	29.3	1-1/2
Current Machine Av.			196.9			2.1	32.9	

TABLE XIV

SUMMARY OF TEST RESULTS FOR MACHINE M
May, 1960

M-1	5- 4-60	E-4	196.8	6.9	0.1	2.9	29.3	1-1/2
Current Machine Av.			196.8			2.9	29.3	

TABLE XV

SUMMARY OF TEST RESULTS FOR MACHINE N
May, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, points Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
N-1	4-19-60	--	195.2	4.0	0.1	1.4	34.7	Min.
N-2	4-22-60	--	195.8	4.8	0.2	1.9	33.8	1/2
N-3	4-25-60	--	195.9	5.3	0.0	2.6	33.7	1
N-4	4-28-60	--	196.0	2.7	0.0	1.1	34.2	1/2
N-5	4-29-60	--	196.3	5.0	0.1	1.9	36.4	1/2
N-6	5- 3-60	--	196.1	3.0	0.1	1.7	32.0	1/2
N-7	5- 6-60	--	197.1	5.1	0.1	2.2	36.4	1/2
N-8	5-10-60	--	196.9	5.5	0.1	2.0	36.2	1-1/2
N-9	5-13-60	--	197.5	4.5	0.3	2.0	33.2	1
Current Machine Av.			196.3			1.9	34.5	

TABLE XVI

SUMMARY OF TEST RESULTS FOR MACHINE O
May, 1960

O-1	4-19-60	35	195.3	9.5	0.1	3.5	31.8	1-1/2
O-2	4-20-60	36	196.1	5.9	0.3	2.8	31.6	1-1/2
O-3	4-26-60	37	193.9	6.5	0.0	2.2	31.0	1-1/2
O-4	4-28-60	38	195.5	5.5	0.0	2.4	30.9	1-1/2
O-5	5- 4-60	39	194.5	7.9	0.2	3.9	29.5	1-1/2
O-6	5-10-60	40	194.2	5.6	0.3	2.1	31.8	1-1/2
Current Machine Av.			194.9			2.8	31.1	

TABLE XVII

SUMMARY OF TEST RESULTS FOR MACHINE P
May, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, points Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
P-1	4-12-60	395	194.9	5.6	0.1	1.6	34.5	1-1/2
P-2	4-20-60	396	196.9	5.8	0.1	2.2	34.9	1-1/2
P-3	4-22-60	397	195.7	6.2	0.1	2.9	36.2	1
P-4	4-26-60	398	196.6	2.9	0.3	1.6	37.0	1
P-5	4-29-60	399	196.3	4.6	0.1	1.9	34.9	1-1/2
P-6	5- 3-60	400	197.5	3.1	0.1	1.5	35.8	1-1/2
P-7	5- 5-60	401	196.7	3.9	0.0	1.3	35.7	1-1/2
P-8	5-10-60	402	196.2	4.7	0.0	1.5	34.1	1-1/2
Current Machine Av.			196.4			1.8	35.4	

TABLE XVIII

SUMMARY OF TEST RESULTS FOR MACHINE Q[a]
May, 1960

Q-1	3-23-60	3749	196.0	4.0	0.0	2.3	32.4	1/2
Q-2	3-28-60	4558	195.2	3.7	0.0	1.4	35.4	1
Q-3	3-31-60	5006	199.0	6.6	0.3	2.8	27.8	Min.
Q-4	4- 5-60	504	196.7	2.2	0.0	0.9	31.0	1
Q-5	4- 6-60	636	197.9	4.6	0.2	1.6	32.3	1/2
Q-6	4-10-60	1038	196.0	4.3	0.2	2.2	30.1	1
Q-7	4-14-60	1985	196.2	4.5	0.0	1.6	32.3	1
Q-8	4-21-60	2903	196.8	4.1	0.2	1.7	34.3	1-1/2
Q-9	4-28-60	4103	196.6	4.1	0.5	1.7	32.1	1-1/2
Q-10	4-30-60	4486	196.9	3.6	0.2	1.5	31.6	1
Q-11	5- 3-60	543	197.1	3.0	0.0	1.0	32.1	1
Q-12	5- 4-60	732	196.3	4.7	0.1	1.7	32.1	1
Q-13	5- 6-60	974	196.9	3.6	0.0	1.1	32.2	1
Current Machine Av.			196.7			1.7	32.0	

[a] Some of the rolls from this company arrived too late for inclusion in last month's report.

TABLE XIX

SUMMARY OF TEST RESULTS FOR MACHINE R
May, 1960

Code	Date Made	Mill Roll No.	Caliper, pt.	Caliper Difference Between Consecutive Flutes, points Max.	Min.	Av.	Single-Face Flat Crush, p.s.i.	Runability (Maximum Tension at 600 f.p.m.), lb./in.
R-1	4-20-60	327	196.3	5.7	0.1	2.5	33.8	1-1/2
R-2	4-21-60	328	195.8	5.3	0.1	2.4	33.8	1
R-3	4-27-60	329	195.7	7.1	0.3	3.6	31.0	1-1/2
R-4	4-29-60	330	196.1	4.0	0.5	1.8	31.9	1-1/2
R-5	5- 5-60	331	197.4	4.4	0.0	1.5	32.3	1-1/2
R-6	5- 6-60	332	196.1	4.8	0.4	1.8	33.6	1-1/2
R-7	5-11-60	333	196.4	5.4	0.2	3.0	30.9	1-1/2
R-8	5-13-60	334	196.1	5.0	0.1	1.9	32.7	1
R-9	5-18-60	335	196.5	6.7	0.4	3.3	34.5	1-1/2
Current Machine Av.			196.3			2.4	32.7	

TABLE XX

SUMMARY OF TEST RESULTS FOR MACHINE S
May, 1960

S-1	5-3-60	561	195.6	2.6	0.0	0.8	33.8	1-1/2
S-2	5- 5-60	562	195.1	7.0	0.6	3.1	38.0	1-1/2
S-3	5-10-60	563	194.7	2.4	0.1	1.1	35.9	1-1/2
S-4	5-19-60	564	195.6	5.4	0.0	1.6	36.8	1-1/2
S-5	5-19-60	565	196.0	4.0	0.0	1.6	36.1	1-1/2
Current Machine Av.			195.4			1.6	36.1	

TABLE XXI

SUMMARY OF TEST RESULTS FOR MACHINE T
May, 1960

T-1	4-15-60	86	194.7	5.0	0.0	1.7	33.5	1-1/2
T-2	4-25-60	87	196.0	5.0	0.0	2.6	38.9	1
T-3	4-29-60	88	195.4	3.9	0.1	1.3	33.6	1
T-4	5- 1-60	89	196.1	2.8	0.0	1.3	33.7	1-1/2
T-5	5- 7-60	90	196.1	3.9	0.0	1.7	31.4	1
Current Machine Av.			195.7			1.7	32.2	

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